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ABSTRACT

The purpose of this study was to compare the effects of temporal positioning of teacher-conducted reviews on the retention of meaningful material presented in the classroom at the community college level. The specific objective was to determine the most effective time to give teacher-summary reviews on in-class presented material as an aid to student retention. An experimental comparison was administered at Central Texas College to assess the effects of three review treatments as identified according to their temporal position. The treatments included teacher-summary reviews given immediately following a class session, teacher-summary reviews given before the next class session, and combined teacher-summary reviews given both immediately preceding and immediately following the class sessions. A control group received no reviews. Subjects were 63 freshman students enrolled in one of two night sections of basic English grammar. Each of four randomly selected groups received their respective treatments from the same instructor over 11 class sessions. Results indicated that receiving some form of teacher-summary review, immediate, delayed, or a combination of the two, is significantly better for student retention and performance than receiving no reviews. In rank order, the immediate review group and the combined immediate and delayed review group performed higher than the the delayed review group. There was no significant difference between the immediate and the combined review groups. (Author/RAO)

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A COMPARISON OF THE EFFECTS OF TEMPORAL POSITIONING OF REVIEWS ON THE RETENTION OF MEANINGFUL MATERIAL

PAUL A. ZEISS

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A MAJOR APPLIED RESEARCH PROJECT
PRESENTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
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Dr. Anita Barrett, Tarrant County Junior College

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Abstract of a Major Applied Research Project Presented to Nova University in Partial Fulfillment of the Requirements for the Degree of Doctor of Education

A COMPARISON OF THE EFFECTS OF TEMPORAL POSITIONING OF REVIEWS ON THE RETENTION OF MEANINGFUL MATERIAL

By

Paul A. Zeiss

February, 1979

The purpose of this study was to compare the effects of temporal positioning of teacher-conducted reviews on the retention of meaningful material presented in the classroom at the community college level. The specific objective of this study was to determine the most effective time to give teacher-summary reviews on in-class presented material as an aid to student retention. An experimental comparison was administered at Central Texas College to assess the effects of three review treatments as identified according to their temporal position. The treatments included teacher-summary reviews given immediately following a class session, teacher-summary reviews given before the next class session, and combined teacher summary reviews given both immediately preceeding and immediately following the class sessions. A control group was included in the study and received no reviews.

The study involved 63 freshman students enrolled in one of two night sections of basic English grammar. Each of the four randomly selected groups received their respective treatment from the same instructor over eleven class sessions. Two criterion retention tests were administered to the four groups and the test scores were combined. The resulting data were used in a one factor analysis of variance

coupled with the Sheffe technique for multiple comparisons. The one factor in the analysis involved only the temporal positioning of reviews.

The null hypothesis was tested with the one-way ANOVA with .05 as the acceptable probability level. A significance resulted from the ANOVA and the test for multiple comparisons revealed specific significant differences between the four treatment means. There was a significance in the mean scores between the immediate review group and the no review group, between the delayed review group and the no review group, and between the combined immediate and delayed review group and the no review group. A significance also existed between the immediate review group and the delayed review group and between the combined immediate and delayed group and the delayed group. There was no significant difference between the immediate review group and the combined immediate and delayed review group.

From an analysis of the data, it is clear that receiving some form of teacher-summary review, immediate, delayed, or a combination of the two, is significantly better for student retention and performance than receiving no reviews. In rank order, the immediate review group and the combined immediate and delayed review group performed higher than the delayed review group. There was no significant difference between the immediate and the combined review groups. This suggests that it may be uneconomical to include both an immediate and a delayed review in the classroom since the single treatment of an immediate review will have virtually the same effect on student retention and performance.

The conclusions of the study were shared with the administrative officials of the college and it is recommended that any expansion or replication of this study should address different variables and conditions which will result in more conclusive and broader implications for teaching and student retention.

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CHAPTER I

INTRODUCTION

Purpose of the Study

The purpose of the study was to compare the effects of temporal positioning of teacher-conducted reviews on the retention of material presented in the classroom at the community college level. The results of the study are expected to be useful in determining whether one temporal position of review or a combination of temporal positions of review is more advantageous in the retention of meaningful instructional material. The research was conducted at Central Texas College.

Background and Significance

Central Texas College is a public supported community college and is part of the American Educational Complex located near Killeen, Texas. The college's sister institutions include the American Preparatory Institute, a private competency-based high school, and the American Technological University, a private upper-level educational institution which offers bachelor's and master's degrees.

This complex of institutions was developed in ten years to service the needs of industry, commerce, government, and the military on a world-wide basis. With the combined resources of the American Preparatory Institute, Central Texas College, and the American Technological University, technologically oriented instruction is being provided from the most elementary to the most advanced levels.

Central Texas College is at the hub of this technological services system. The college is located adjacent to Ft. Hood, the largest military base in the world. A close alliance with the military helped Central Texas College to win the U. S. Army vocational education contracts at most Army reservations in Europe and Korea. The college has also secured vocational training contracts with the U.S. Air Force in Alaska and Europe and with the U.S. Navy in the South Pacific and Europe. The Continental and Overseas division of the College annually provides credit courses to 6,500 military personnel at 150 extension sites around the globe. This site figure does not include three domestic extensions and a score of Naval ships in the South Pacific where college courses are being offered.

The Central Texas College main campus is serving another six thousand students, both military and civilian, with academic and technical-vocational courses. The college daytime enrollment is only slightly less than the night time enrollment due to the largely military prpulation which makes up a majority of the night class enrollments. Daytime students include traditional civilian students and military students. The college is located in an area with a highly transient population. Additionally, the military enrollment in night courses fluctuates as a result of the ever changing military post population. Because of this high degree of mobility and the fluctuating military population, a large number of part-time faculty are employed by the college.

Most of the part-time instructors are local tradesmen who have had little formal training in educational methods. Full-time instructors have received formal training in general educational

methods, but the students at Central Texas College are demographically unique and it is believed that the teaching methods learned may not have been valid when applied to the college's students. Local research in the area of learning theory was of interest to college officials since knowledge of such targeted research would allow for locally-based recommendations to be made to full-time and part-time instructors.

It was believed that the uniqueness of the educational setting and the students at Central Texas College might invalidate the research results previously derived from similar studies on review and retention which used more traditional educational settings and students. It was therefore important that a campus-based study on the effects of review positioning on student retention be administered.

The question of the most advantageous time for the review of in-class presented material was originally of interest to the Education Department of the American Technological University and was later of significant interest to the Dean of Central Texas College. The research at Central Texas College was a result of a previous research study which was endorsed by and conducted at the American Technological University (Appendix A). The results of the University study (Zeiss, 1978) which compared the effects of immediate and delayed reviews on the retention of material presented in the classroom were shared with the deans of instruction for all the educational entities at the American Educational Complex. These results sparked an interest in the subject with Central Texas College officials and an expanded study at the college level was encouraged and endorsed (Appendix B).

The results of this study were supplied to the deans of instruction for all the educational entities at the American Educational

Complex and were given to all Central Texas College department managers with appropriate recommendations for use with part-time instructors. It was stated in the research proposal that if one temporal position, or a combination of positions was found to be most advantageous, it would be recommended that Central Texas College instructors exercise such review procedures in their classes. Subsequent recommendations were made following an analysis of the data.

The degree of retention of material presented in formal classroom settings has been the topic of significant research especially since the 1930's. Of special interest have been the effects of review or the practice of learned material as it pertains to temporal positioning. The question of when the review of learned material was most advantageous in terms of retention has been deemed of much importance to learning (Peterson, 1935; Sones, 1940; Ausubel, 1968; Gay, 1973; Horwitz, 1975; Vitro, 1975).

One of the more noted researchers in this area, D.P. Ausubel (1968), stated that the issue of immediate versus delayed review had significant implications for student study practices and for the programming of meaningful instructional materials. Credible arguments, said Ausubel (1968), can be adduced in support of each alternative, but the issue can be solved only through empirical testing.

It had been speculated that most learning theories assume that the strength of learning, and therefore resistance to forgetting, varied according to the number of practice or review sessions (Reynolds, 1964). In reality, there have been conflicting results in research studies dealing with this topic. Attempts to determine if the strength of learning actually varied according to the number of reviews were

complicated with at least three major variables. These variables included the type of learning involved, meaningful or non-meaningful, the time or temporal positioning of the reviews, and the type of review being administered, i.e., teacher summaries, notetaking, or practice.

It appeared that studies utilizing non-meaningfully related material, such as nonsense syllables or random numbers, had been consistent in their findings that increased review or repetition lead to better retention (Tulving, 1968; Underwood, 1964; Gay, 1973). For meaningfully related material such as classroom instruction in prose or mathematics, reviews appeared to have significance in promoting retention (Ausubel and Youssef, 1965; Reynolds and Glasser, 1964).

With the measurement of the effects of spaced reviews came the question of the best optimal spacing or temporal positioning of such reviews. Although much research had been accomplished in this area, there appeared to be no conclusive evidence that any particular review time, immediate, delayed, or a combination of the two, was better in terms of student retention. In fact, research was found to illustrate opposing viewpoints.

Vitro (1975) suggested that deliberate recall immediately after learning reduced the possibility of forgetting new material. Horwitz (1975) and Gay (1973) stated that delayed review significantly enhanced retention. Sones (1940) stated that delayed review was only slightly more effective for retention than immediate review, and Ausubel (1968) stated that immediate and delayed reviews were equally effective for the retention of learned material, and a combination of the two review times might be advantageous for the learner. The sequential spacing

of reviews was reported to facilitate the retention of meaningful material by Reynolds and Glasser (1964), while blocked or contiguous review was reputed to be better than spaced or interpolated review in a study conducted by Scanlon and Frederick (1967). The topic concerning the most advantageous review positioning is still of much relevance in today's colleges and it is believed that the effects of reviews have been inadequately investigated for the retention of meaningful material (Gay, 1973).

With regard to the type of review being administered, much emphasis has been placed on the investigation of reviews by notetaking, practice, and teacher summaries. The results of research conducted on these types of reviews are not harmonious. For instance, the use of lecture summaries as reviews was shown to be inferior to the use of subject-generated notetaking as review devices by Thomas (1975). However, the benefit of notetaking over teacher conducted reviews had been ascribed to the subsequent opportunity of students to review their notes as opposed to the notetaking itself (Von Matre and Carter, 1975). In the area of verbal reviews, it appeared that there was no significant difference in the retention of orally presented material between previews or reviews or with neither previews nor reviews (Vickery, 1970).

Research in the value and optimum benefits of practice as a form of review exhibit equally inconclusive results. In a study by Kleinman (1976), it was discovered that the effects of practice distribution on the acquisition of motor skills demonstrated no significant differences between the different temporal positions of practice sessions. On the contrary, Ausubel and Robinson (1967) stated that

evidence supported the conclusion that distributed practice was more effective than massed practice for both learning and retention.

In assessing the interests of Central Texas College, it was considered most relevant and useful to conduct research on only meaningful material by comparing the effects of no reviews, immediate reviews, delayed reviews, and a combination of both immediate and delayed reviews, and by using only teacher-conducted summary reviews. It was believed that research on the temporal positions of the review of meaningful material would be most practical and useful to the students at the college since most college instruction deals only with meaningful material. Further, teacher conducted summaries were viewed as being the most economical and practical method for reviews in the college setting.

Definition of Terms

Class session. A fifty (50) minute formal classroom meeting of students and an instructor.

Contiguous review. Review that is adjacent in time, immediately preceeding or following; blocked.

Delayed review. A teacher's verbalized summary of all the major points presented in a class session which immediately precedes the next class session; at least two, but not more than four days following the class session.

Grade achievement. The numerical score achieved on a written examination that is administered to all students.

Immediate and delayed review. Two identical teacher summaries of the major points presented in a class session; one immediately

following the class session and one immediately preceding the next class session.

Immediate review. A teacher's verbalized summary of all the major points presented in a class session which immediately follows the class session.

Meaningful material. Information that has meaning, function or purpose.

Practice. To exercise or review repeatedly.

Retention. The absence of forgetting; retaining information in memory.

Review. A teacher's verbalized summary of all major points previously discussed in a class session.

Spaced review. Review that is spaced or interpolated over a period of time.

Temporal positioning. Pertaining to different positions of time, i.e., immediate or delayed.

Independent variable. The temporal positioning of review - either immediate, delayed, or a combined immediate and delayed review.

Dependent variable. The grade achievement of students involved in the study.

Assumptions

1. Students involved in the study had received equal chances of being placed in any of the four groups.

2. Grade achievement was one valid measure of the students' retention of instructional material presented in the classroom.

3. The effects of grade assignment prejudice were equally dispensed throughout the two groups.

4. The students in both English classes were at simiiar competency levels in English grammar.

Limitations

1. The population was limited to students enrolled in two sections of a basic English grammar class at Central Texas College, and the findings might not be easily generalized to apply to other subjects or other colleges.

2. The population was limited to students enrolled in two evening classes and the findings might not be easily generalized to apply to daytime classes.

3. The reviews were given in the form of live teacher-summaries and included student discussions which created slight variations in the review processes as received by different groups.

4. It was recognized that the results of this study would be applicable to retention when relatively short periods of time had passed and might not apply when longer periods of time had passed.

CHAPTER II

REVIEW OF THE LITERATURE

The problem of forgetting or lack of retention of classroom presented concepts appears to have warranted significant research over several years. Numerous studies over the last four decades have included various aspects and experimental approaches surrounding both short term and long term retention. With all the physiological research on man's information-retrieval process, it is still not known whether human memory is chemical or electrical, highly structured or random, and whether it has unlimited storage space or must be continuously culled to make room for new information (Rowan, 1978). Most recently, at least four variables concerning memory and retention factors have been researched extensively. These include the effects of contextual environment on retention, the effects of the amount of original learning on retention, the effects of the length of recall intervals on retention, and the use of reviews or repetition as aids to the retention of learned material (Jensen and Anderson, 1969; Nelson and Lawson, 1972; Woodward, 1973; Ausubel, 1968; Gay, 1973).

Research on the subject of retention has included non-meaningful material and meaningful material including lists, numbers, and concepts (Shay, 1964; Ausubel and Youssef, 1965; Young, 1972). Some experimental studies in the area of retention have dealt exclusively with intentional forgetting of non-meaningful material and have suggested that retention must be divided into two categories of storage

and recall (Bruce, 1974). There have been more numerous studies, however, regarding the retention of intentionally learned meaningful material where retention is treated as one unit of measurable behavior (Reynolds and Glasser, 1964; Ausubel, 1968).

Despite the various approaches in researching the subject of retention, it is clear that the need for a greater understanding of how we learn and retain information is of much importance to educators and society. For instance, Pressey, Robinson, and Horrocks (1959) determined that only 25 percent of the concepts learned in high school and college courses are retained after two years. This 75 percent loss rate represents a serious problem for education, and such findings give evidence to the need for continued research in this area of learning theory.

In a series of seventeen experiments, Jensen (1969) attempted to assess the effects of ambient contextual stimuli on retention. In these retention experiments, the recall sessions were located in a context unlike the room used during original learning. Meaningful and non-meaningful materials were involved in the experiments. Retention losses occurred following contextual changes when nonsense materials were used, but not when connected discourse or classroom materials were employed. Students involved in the study had significant losses in the retention of nonsense material when the retention tests were administered in a different contextual environment from the environment where the original learning took place. There was no significant loss in the retention of meaningful material when the same changes in contextual environment occurred.

Other recent research studies on retention have been concerned more with the aspects of original storage than with forgetting. There appears to be a saturation point in original learning which affects forgetting. Nelson and Lawson (1972) attempted to assess the relative importance of the length of material to be learned as a major variable that affects forgetting. Their experiment suggests that the primary effect of the length of material to be retained in long term memory is on storage rather than on forgetting. The implication is that once something is really learned (stored), it is not likely to be easily forgotten and that humans can store only a limited amount of information per exposure to new material.

A recent study by Woodward (1973) suggests that one significant key to remembering learned material is in the original processing time. In a series of eight experiments dealing with intentional forgetting, it was found that the recognition of remember and forget items was positively related to the length of the time for processing; the more processing time allotted to an item, the more likely it was to be remembered. Further, Woodward discovered that when subjects were explicitly told not to remember an item when first shown the item, the degree of later recall of that item was significantly less than when subjects were only implicitly instructed, after a delay in time, to forget an item. There appeared to be a positive correlation between the amount of original storage processing and the degree of later recall. Winne (1973), on the other hand, reported that college students learned information more efficiently with implied repetitions than with explicit repetitions. It was theorized that the explicit repetition condition produced memory storage interference. These results were

produced with the involvement of meaningful material of "chunked" or independent nature.

At least one comprehensive study on retention examined the instances of difficulty of material to be learned, the methods of presentation of material to be learned, and the effects of augmented review on learned material (Young, 1972). Young's study dealt primarily with concept learning and the interaction of these three variables. It was concluded that there was no significant difference in retention or recall between the methods of presentation of original concept material where simultaneous and sequential methods were used. The most efficient means of promoting the learning and retention of concepts, however, was to use both easy and hard instances of difficulty of material to be learned and to augment the original presentation of material with a specific review as opposed to a partial or no review.

Another study in the area of retention suggests that there is a difference between retention and recall, and this difference should be considered when conducting retention research (Bruce, 1974). In the Bruce experiments, retention did not appear to be as much of a problem as did recall. Experiments on non-intentional forgetting indicated that storage and retrieval were two different phenomena. Bruce suggested that information may be in the memory, but there can be simply a failure to assess fully the appropriate information. Perhaps more important than the distinction between storage and recall, the Bruce experiments indicated that selective rehearsal or review may be at the root of a number of situations in which at least short-term memory is facilitated. The tests were not conclusive, but it was

suggested that the real value and essential nature of rehearsal or review is to identify retrieval information or cues in order to locate and extract information from memory.

When reviewing any experimental research, it can be postulated that the most significant experiments are those which prove most useful and most practical. In the area of retention, perhaps the most significant research is that which considers the application of learning techniques used in the classroom.

The degree of retention of material presented in formal classroom settings has long been the topic of significant educational research. The study of retention has been recognized for its important potential application to learning theory and instructional effectiveness (Gay, 1973). Most learning theories assume that the strength of learning or the resistance to forgetting varies as a function of the number of repetitions (Reynolds and Glasser, 1964). In contrast, several investigations reviewed by Welborn and English (1937) indicated that the retention of meaningful material tends to remain unchanged regardless of the amount of repetition during original learning (Reynolds and Glasser, 1964).

The subject of repetitions in learning theory research introduced questions about the value of reviews and rehearsals of learned material. Research efforts to connect reviews or rehearsals as facilitative aspects of the retention of learned materials began in the 1930's and are continuing. Specifically, much interest has centered on the effects of review or on the practice of learned material as connected to temporal positioning. The answer to the question of when the review of learned material is most advantageous in terms of

retention has often been seen as one important subject for learning theory research (Peterson, Ellis, Toohill, 1935; Sones, 1940; Ausubel, 1968; gay, 1973; Horwitz, 1975; Vitro, 1975).

With regard to review, studies utilizing non-meaningful material, such as nonsense syllables, revealed a positive correlation between retention and practice. Shay (1964) concluded that retention was better as a result of increased review although overlearning was considered uneconomical. For meaningful material, that which is taught in the classroom, a positive correlation between practices and retention was also found. However, several delayed practices were not found to be more effective than one practice (Horwitz, 1975). Several studies which dealt with the retention and review of meaningful material looked at the temporal position of review more closely. These studies concluded that spaced reviews rather than contiguous repetitions were effective for higher retention (Ausubel and Youssef, 1965; Reynolds and Glasser, 1964). Research concerning spaced reviews introduced a significant question concerning the best temporal spacings of such reviews. That is, should instructors give reviews immediately following lecture or discussion sessions or should the review follow a delay of some unspecified time period? If the reviews are delayed, should they be spaced over time or massed in a few specific time periods (Gay, 1973)?

Reynolds and Glasser (1964) reported that retention is optimized not so much by instructional procedures as by temporal conditions employed in their presentation. In experiments conducted by Bruce (1974), it was suggested that the time or position of input material to be recalled is important, but that the efficacy of temporal

tags as cues for the recall of learned material is not consistent. Ausubel (1968), proposed that the issue of immediate versus delayed review has significant implications for student study practices and for the programming of meaningful instructional materials. Each alternative review, said Ausubel, has its own advantages, but the issue can be solved only through further research and empirical testing.

Most learning theories seem to assume that the retention of learned material varies according to the number of practice or review sessions (Reynolds and Glasser, 1964). In reality, there have been conflicting results with research done on this topic. Studies which have attempted to determine whether the retention of learned material actually varies according to the number of reviews have been complicated with at least three major variables. These variables include the type of learning involved, meaningful or non-meaningful, the time or temporal positioning of reviews, and the type of review being administered, i.e., notetaking, teacher summaries, or practice.

Studies utilizing non-meaningfully related material such as nonsense syllables or random numbers indicate that increased review or a repetition of presented material leads to better retention (Tulving, 1968; Underwood, 1964; Gay, 1973). For meaningfully related material, such as classroom instruction in a legitimate subject area, single and spaced reviews appear to have significance in promoting retention (Ausubel and Youssef, 1965; Reynolds and Glasser, 1964).

In an extensive study on the retention of learned concepts, Jensen and Anderson (1969) compared the retention of nonsense material to the retention of meaningful material in out-of-context situations.

It was reported that retention losses occurred with nonsense material, but not with meaningful material.

Moely (1974) conducted a study on recall cues using both meaningful and non-meaningful cues as recall aids. Both meaningful and non-meaningful cues were found to work as aids in the recall of learned material. It appears that the association of external cues during learning can facilitate recall whether the associated cues are meaningful or non-meaningful. However, there does seem to be a more positive correlation between the incidence of recall and the learning of meaningful material than between recall and the learning of non-meaningful material (Jenson, 1969). Most of the research surveyed indicated that reviews of meaningful material have much significance in the promotion of retention and recall.

The measurement of the effects of reviews quite naturally introduces the question of the best optimal spacing or temporal positioning of such reviews. Much research has been accomplished in this area, yet there is no conclusive evidence that any particular review time, immediate, delayed, or a combination of the two, is better for facilitating student retention. In fact, a review of research on this topic illustrates opposing viewpoints.

Horwitz (1975) and Gay (1973) stated that delayed review significantly enhanced student retention while Vitro (1975) suggested that review immediately after original learning reduced the possibility of forgetting new material. A close examination of these studies and others exemplifies a lack of congruity of research findings in this topical area.

The Horwitz (1975) study compared the effects of immediate practice and delayed practice on the retention of learned rules for seventh grade students. Results of the study indicated that delayed practice was significantly more effective than immediate practice and that immediate practice was not more effective than no practice as a means for providing for retention.

The Gay (1973) study involved two experiments. Experiment one was designed to determine whether the temporal position of review was an important factor in the retention of meaningful material. Experiment two was designed to investigate the thesis that the effects of early and delayed reviews counterbalanced each other. The results of experiment one indicated that the temporal position of one review was not an important factor in the retention of mathematical rules. However, the findings in experiment two indicated that while both early and delayed reviews contributed to greater retention, the contribution of delayed reviews was greater.

Vitro (1975), in a published manual designed for the teaching of classroom principles of learning and instruction, stated that forgetting proceeds most rapidly at first, then more slowly. As a consequence, it was suggested that deliberate recall immediately after original learning reduced the possibility of forgetting new material. Results of a study by Sones (1940) indicated that delayed review was only slightly more effective for retention than immediate review.

Boker (1974) reported that oral review questioning facilitated retention only when interspersed (delayed) over a period of time after the original exposure to factual material. Boker's study involved comparing the effects of preview and review questioning on incidental

learning. Wadsworth and Flagg (1971). however, conducted a study to measure the effects of interspersed questions on meaningful material and found different results. The study, which involved elementary and college students, concluded that there was no general facilitative effect on incidental learning with the use of interspersed (delayed) questions after the relative text material was studied.

Weekly textbook reviews were found to be useful in achieving higher scores on retention tests with material studied in the classroom by Gibson (1965). Gibson concluded that weekly reviews involving textbook questions raised the scores on students' quiz items. Ausubel (1968), appears to have struck a compromise in the controversy when he states that both immediate and delayed reviews are effective for the retention of learned material and the two review times can be combined profitably for the learner.

The Ausubel experiments with the temporal positioning of reviews recognized that previous studies indicated a slight, but non-significant, tendency for delayed reviews to be more effective than early reviews. However, stated Ausubel (1968), the retention tests were given an equal number of days after the original learning regardless of the review time. Hence, the delayed review period held an obvious advantage, and the results tended to be biased. Ausubel's experiments in this regard equated the time intervals between reviews and retention tests. The results indicated that each review time had its respective advantages and that perhaps they could be profitably combined for greater retention. The principal advantage of early reviews was reported to be in the consolidating and sensitizing effect

while the advantage of delayed reviews was in the opportunity to relearn forgotten material.

At least one researcher in the field reported the value and temporal position of reviews to be insignificant altogether. In an expansive study involving the planning of reviews within individualized instruction, Dunn (1971) concluded that reviews did not significantly contribute to performance or retention, that there was no difference in the effectiveness of review formats, and that there was no significant difference between the temporal placements of reviews. However, Reynolds and Glasser (1964) reported that the retention of meaningful material was facilitated by the sequential spacing of reviews.

In the Reynolds and Glasser study, it was concluded that the monotony of repetitions in many programmed instruction curricula may be of little value in enhancing retention and can profitably be replaced by spaced reviews. In any case, the Reynolds and Glasser findings indicated that retention may be optimized more by the temporal conditions of reviews than by the instructional procedures per se.

Yet another viewpoint was expressed in a study conducted by Scanlon and Frederick (1967) where it was reputed that blocked or massed review was better than spaced or interpolated review. The Scanlon and Frederick study involved ninth grade students receiving programmed instruction and was designed to determine if reviews increased learning and if spaced reviews facilitated retention over blocked or massed reviews. Results of the study indicated that the addition of a review to the instruction did not lead to signifi-

greater learning, but that blocked or massed review contributed to greater learning than did spaced review.

A similar finding was published in a final report commissioned by the office of Naval Research (Underwood, 1968). After extensive research, Underwood concluded that the influence of time intervals of a few seconds to several minutes between practices had little influence on the rate of learning, but that long intervals (24 hours or more) between blocks of instruction had an enormous influence on retention. Such a practice schedule was believed to innoculate the learning task against forgetting and would prevent it from interfering with other learning tasks.

Other researchers have suggested that the temporal position of review is of little consequence and that only the relative importance or meaningfulness of the material presented is significant. Vickery (1970) reported that both a recency and a primacy effect appear operative in the human learning process, but opposing results of these effects were found by various investigators. Research by Tannenbaum (1954) and Ehrensberger (1945) indicated that items presented orally near the end of a communication were more easily retained.

More recent experiments by Bruce (1974) suggest yet different effects of recency and primacy on practice and the retention of learned material. Studies in which students were asked to review and recall lists of unrelated words indicated that the effects of both recency and primacy contribute to retention and recall, whereas primacy appeared most significant for first-presented items over last-presented or the most recent items. However, as the experimental session wore on, the level of recall of last-presented items increased. This suggested that

the temporal position of input and review material to be recalled is important, but that the use of temporal tags as cues for recall of learned material is inconsistent. In reality, no one can say with certainty whether recency or primacy is the more effective variable. In any case, there does appear to be a positive correlation between repetition and retention (Reynolds and Glasser, 1964; Vickery, 1970). It is clear that research concerning the most advantageous review positioning is still useful to today's colleges, and it is believed that the effects of reviews have been inadequately investigated for the retention of meaningful material (Reynolds and Glasser, 1964; Gay, 1973; Horwitz, 1975, Ausubel, 1968).

Reynolds and Glasser (1964) stated the point clearly by acknowledging that although periodic review of material previously learned is a prevalent teaching method, little attention had yet been given to a systematic evaluation of its effect upon retention. Gay (1973) stated that the effects of reviews on retention had been inadequately investigated for verbal material and totally ignored for the effects on intellectual skills such as the learning of rules. Further evidence of the need for more research on the relationship between reviews and retention was summed in a recent study by Horwitz (1975). Horwitz stated that little experimental research has been conducted on the relationship between practice trials and the retention of meaningful material despite its immense practical significance for classroom learning. Ausubel (1968), one of the most referenced researchers in the area of retention, stated that the issue concerning the best temporal positioning for reviews is still unresolved and needs more research.

Considerable emphasis has also been placed on the type of review being administered. Specifically, the effects of notetaking, teacher summaries, and practice have been of interest. The results of research conducted on these three types of reviews were not harmonious. For instance, the use of teacher summaries as reviews were reported as inferior to the use of subject-generated notetaking as review devices (Thomas, 1975).

In the Thomas experiment, it was determined that groups which reviewed with lecture summaries recalled more information than groups which had no reviews, but groups which took notes, either during or after the original lecture, recalled more information than those groups which received summary reviews but took no notes. The groups which both took notes and received lecture summaries recalled more information than groups which received just reviews or only took notes. However, the benefit of notetaking over teacher summary reviews has been ascribed to the subsequent opportunity for students to review their notes as opposed to the notetaking itself (Von Matre and Carter, April 1975).

In another study by Carter and Von Matre (December, 1975), it was suggested that the reviewing of notes inhibits the recall of irrelevant material. Learners who could review notes appeared to focus more effectively on only the pertinent information contained in the notes. In the same study, Carter and Von Matre concluded that notetaking coupled with a review of the notes represented a useful strategy for recall, but that notetaking alone was of questionable value.

Fisher and Harris (1973) suggested, however, that the value of notetaking lies both in the process itself as an encoding function and in the opportunity to review the notes as an external memory function. It was indicated that the review of notes as an external memory device had the greater effect on recall, but taking notes without reviewing them was still better than not taking notes at all.

Experiments by Divesta and Gray (1972) support the idea that notetaking facilitates recall as an encoding function. Instead of interfering with learning, stated Divesta and Gray, notetaking seemed to sensitize the learner to the concepts being presented in lecture. It was concluded that the increased attention given to the original communication increased the probability that the concepts would be retrieved even though the notes might not be reviewed. Annis and Davis (1977) suggested that research studies which attempted to find differences between the retention of notetaking students and non-notetaking students were not entirely valid. The variable of student preference in studying techniques, i.e., notetaking, reading, or underlining, was determined to seriously affect such studies.

The taking of notes as a form of review appears to be a useful strategy as an aid to learner recall, but there are several variables that have not yet been dealt with conclusively. In an extensive study involving verbal communication, Peters (1972) found that significantly more correct responses were made on retention tests by subjects who were not engaged in taking notes than by those actually taking notes. Peters then attempted to compare the usefulness of notetaking for recall to the rate of presentation. Those findings suggested that there was an interaction between the presentation rate

and notetaking, but the crossover point (positive or negative interaction) varied with the individual's processing efficiency. Low-aptitude scorers performed better by not taking notes at faster than normal rates of presentation. High-aptitude scorers performed equally well by taking notes or not taking notes.

Another variable which needs to be clarified concerns the relationship between the type and difficulty of lecture material to notetaking (Peters, 1972). There was also evidence that students take notes differently and that little is known about the relationship between the style of notetaking and its effect on the efficiency of recall. Divesta and Gray (1973) recognized that students take notes in at least three different coding aspects and pointed out the need for more extensive research with regard to notetaking as a type of review.

In the area of teacher summaries, there appears to be no significant difference in the retention of orally presented material among listeners receiving previews, reviews, or neither previews nor reviews (Vickery, 1970). In this study, college students on the same academic level were placed into three groups which listened to an audio recorded presentation. One group received a preview of the main points with the presentation, one group received a review of the main points with the presentation, and one group received the presentation without a preview or a review. A delayed retention test revealed no significant differences among the groups.

There also appears to be no significant difference in the retention of classroom presented material between immediate and delayed teacher summaries (Zeiss, 1978). In this experimental study,

which involved college students, there was no control group. One group received teacher-summary reviews immediately following each class session and one group received identical teacher-summary reviews at the beginning of each subsequent class session. After eight weeks and sixteen class sessions, a retention test on the reviewed material was administered. The findings revealed no significant difference between the mean test scores of the two groups. Since there was no control group, it was impossible to determine if the oral summaries actually facilitated student retention.

It was reported in a study by Ross and Divesta (1976), however, that the participation in oral reviews has a positive influence on retention. In an experimental study designed to determine the relationship of oral reviews to retention, Ross and Divesta concluded that students who actually presented oral summaries of in-class material during review sessions scored appreciably higher on retention tests than did students who merely listened to oral summary reviews or students who received no reviews. It was noted, however, that students who listened to oral summary reviews scored higher on retention tests than the control group of students who received no reviews.

Although teacher summaries appear to be the most practical form for the review of in-class presented material, the intra-variable of student anxiety should be acknowledged. Ross and Divesta (1976) addressed the problem and concluded that the anticipation of and participation in oral review activities did produce anxiety, but such anxiety could actually facilitate performance. They also concluded that if a student displays a reluctance to participate in oral reviews, it may be to his ultimate disadvantage. In any case, the research

available on the specific value of reviews as teacher summaries or participating student oral summaries is limited and therefore can be considered inconclusive.

Equally inconclusive results are exhibited by research concerning the benefits of practice as a form of review. A study by Kleinman (1976) indicated that the effects of practice distribution in regard to the acquisition of motor skills are not significant between different temporal positions of practice sessions. On the contrary, Ausubel and Robinson (1969) gave evidence to support the conclusion that distributed practice is more effective than massed practice for both learning and retention. Other research indicates that the effectiveness of practice sessions is dependent upon the type of learning involved. Hull (1968) studied the effect of practice upon the performance of manipulative and intellectual tasks. It was concluded that a practice period is more effective than a mere repetition of the training in the improvement of performance on the manipulative task. No such difference in effectiveness was obtained on the intellectual task, however.

A study by Bruning (1968) addressed the relationship of infrequent self-testing as a form of practice review on the retention of prose material. It was concluded that such practice testing had facilitative effects both in conjunction with and independent of oral reviews of the actual content to be learned.

The value of testing as a method of practice was also supported in an experiment involving the learning of spelling words by seventh grade students (Reith, 1974). The study involved two practice systems. In one system, the students received a portion of the weekly spelling

words daily, but without the daily tests. In the other system, the students received a portion of the weekly spelling words daily with daily tests. The students who received both a portion of the words daily and daily tests achieved the highest scores on weekly spelling tests. The control group which received all the spelling words at the beginning of the week and no daily tests achieved significantly lower scores on weekly tests than either group which received a practice treatment. Student-initiated and teacher-initiated multiple choice questions were used as forms of practice in a study conducted by Adejumo (1976). The study was designed to measure the effects of practice questioning on student retention. Results of that experiment indicated that practice questions, regardless of their source, did facilitate student retention in the learning of prose material. It was noted, however, that more research was needed regarding the level of difficulty of the textual material being studied.

From the research reviewed, it appears fairly conclusive that practice sessions as a form of review facilitate retention and recall. However, there also appears to be limited research available on the question of matching the appropriate type of practice session to the particular type of learning involved.

The inconclusiveness and number of intra-variables involved with the three primary variables addressed in this review of literature led the researcher to focus attention on only the primary variable of retention as it relates to the temporal position of reviews. Further, the value of any research involving college students and formal classroom atmospheres appears to be in its obvious usefulness and immediate application. Accordingly, it was determined that teacher-summary

reviews are the most practical in the college setting and therefore were used in this experimental study. As a result of the literature reviewed, with knowledge of the research question in mind, and with an awareness of the interest in the topic by the Central Texas College administration, a comparative study on the retention value of various temporal positions of teacher-summary reviews of instructional material presented in the classroom was proposed and administered.

CHAPTER III

DESIGN OF THE STUDY

Summary of Purpose

The purpose of the study was to determine the most effective time to give reviews on in-class presented material as an aid to student retention. A comparison was administered to determine the effects of temporal positioning of teacher-conducted reviews on the retention of instructional material at the community college level. The results of the study were expected to be useful in determining if one temporal position or a combination of positions of review was more advantageous in the retention of meaningful instructional material.

The study was conducted at Central Texas College, a public community college serving a largely military population. The results involved a study design which compared the effects of no reviews, immediate reviews, delayed reviews, and a combination of immediate and delayed reviews as they related to student retention.

Sample

The sample population used in the study involved approximately 65 freshman students enrolled in two sections of basic English at Central Texas College. Both English course sections were identical in subject matter, met two nights weekly and were taught by the same instructor. The students enrolled were representative of typical

evening college students in that at least 80 percent were in the military and were taking college credit courses on a part-time basis.

Design

A quasi-experimental design, as described by Isaac and Michael (1972), was used in the study since it was recognized that there were many uncontrolled variables which could contribute to the effect on the dependent variable. Further, it was recognized that the sample population was derived from two major groups, English classes, that were already established and could not have been randomly selected.

From these two sections of an English grammar class, four groups were randomly selected to receive respectively different treatments. Group A received no teacher-conducted reviews. Group B received immediate reviews. Group C received delayed reviews. Group D received both immediate and delayed reviews. Class I, which met on Monday and Wednesday evenings, was divided into equal groups A and B. Class II, which met on Tuesday and Thursday evenings was divided into equal groups C and D. The treatment groupings were selected in an effort to minimize the differences between any two groups within one class. For example, to place the no review group in the same class section with the immediate and delayed review group could have created more student attention to the experimental condition than by placing the no review group in the same class with the immediate review group (See Table I).

TABLE I

Groups and Treatments

	GROUPS	TREATMENT
CLASS I	A	No Review
	B	Immediate Review
CLASS II	C	Delayed Review
	D	Immediate & Delayed Review

Table I displays the four random groups, as determined from two classes, and the treatment each group received. The four cell groups were represented by the letters A, B, C and D.

The students in each class were randomly divided into the respective groups by a coin flipping method. Each student was asked to flip a coin. The instructor then asked for the students' results, heads or tails, from a random order of the students' names. All "heads" were assigned to one group and all "tails" were assigned to the other group. This random selection process took place in both classes to determine the four random groups to be used in the study. The students in the study were informed about the purpose of the research, but only in a very general manner which did not involve significant detail and did not reveal any hypothesis.

The study involved approximately eight weeks or fifteen class meetings at two meetings per week. The reviews were ten minutes in length and involved teacher summaries and student-teacher discussion.

The reviews, as given to each group, were as nearly identical as possible. Each review period covered the main points discussed during the regular instructional period regardless of the temporal position of the review.

No reviews of the major points of instruction were received by group A. Group B received reviews of the major points of instruction immediately following the end of each class session. Group C received duplicate reviews of the major points of instruction immediately preceding the next scheduled class session. This schedule involved minimum review delays of two days and maximum review delays of four days. Group D received both immediate and delayed reviews. Duplicate reviews of the major points of discussion were received immediately after and immediately preceding the next scheduled class session (See Table II).

The classes used in the study met twice weekly for one and one-half hours during each session. Groups A and B met on Monday and Wednesday evenings from six until seven-thirty. Groups C and D met on Tuesday and Thursday evenings from six until seven-thirty. Ten minutes of class time was reserved at the beginning of each class period for groups B and D which received immediate reviews. Ten minutes of class time was also reserved at the end of each class session for groups C and D which received delayed reviews. Those groups not receiving reviews at a particular time did not attend the reviews.

TABLE II

Treatment and Retention Tests Times

		Week I	Week II	Week III	Week IV	Week V	Week VI	Week VII	Week VIII
		1, 2	3, 4	5, 6	7, 8	9, 10	11, 12	13, 14	15, 16
CLASS I	(Group A)	N N	N N	N N	T N	N N	N N	N N	T
	(Group B)	I I	I I	I	T I	I I	I I	I	T
CLASS II	(Group C)	D	D D	D D	T	D D	D D	D D	T
	(Group D)	I ID	ID ID	ID D	T I	ID ID	ID ID	ID D	T

N = No review

I = Immediate review

D = Delayed review

ID = Immediate and delayed review

Table II represents the design of the study as reduced to two class meetings per week for eight weeks. The treatment was given for five class meetings followed by a retention test and for six additional class meetings followed by a retention test.

Measurement

Groups B, C and D received reviews over five identical class sessions and an objective test was administered over the subject matter presented. Group A received no reviews over the class sessions, but served as a control group and received the same in-class instruction and the same test. Groups B, C and D then received reviews over six identical class sessions and another objective test was administered. This test involved only the subject matter presented in the last six class sessions. Group A received no reviews over the class sessions, but received the same in-class instruction and the same test.

Both examinations were objective and included only subject matter presented during the instructional periods when reviews were administered. The examinations were administered on the seventh and the fifteenth weeks. The examinations did not include material presented on the sixth class meeting or on the fourteenth class meeting (See Table II). Each examination involved 100 total points possible. No review was given to any group on the seventh or fifteenth weeks to avoid a possible contamination of the study in which the test would be given on the same evening that groups C and D, but not B, received a review.

The grade achievements of all students in the study, as measured by the two written examinations, were assessed as determinants of

retention. The achievement scores of all four groups were compared to determine if there was any significant difference among the treatments.

The administration of two tests to be combined and used in the statistical analysis was viewed as a stabilizing factor which represented a more valid measure of actual significance, if any, derived from any of the four treatments. The treatment in the study began approximately four weeks after the school semester commenced. This delayed implementation of the treatment was seen as an advantage in the design since anxieties involving teacher and student expectations were diminished. The delayed implementation of the treatment acted as a leveling factor in the study.

Much discussion about the best temporal positioning of reviews had centered on the unequal time interval between the last reviews and the time the examination was administered. Research results concerning the use of an equated interval between original learning and retention tests and concerning the use of an equated interval between the review and retention tests were similar. The evidence implied that both approaches yielded almost the same results (Horwitz, 1975). In designing the study, it was believed that an equated time interval between original learning and the retention tests was more practical in a pedagogical sense and was, therefore, used in the study.

Research studies of this type frequently must take precautions against a variable known as the Hawthorne effect (Turney and Robb, 1971). The Hawthorne effect may invalidate a study in which the subjects in the study begin to react to the research condition in an exaggerated or atypical manner rather than to behave normally under the treatment involved. If a Hawthorne effect did occur in the

study, it was believed that it affected all subjects equally regardless of any group differentiation. All students were informed about the general purpose of the research, but were given no details or research expectations. It was assumed that the Hawthorne situation was not a significant factor in this study.

Statistical Analysis

To effect the proposed comparison of grade achievement levels among students in groups A, B, C, and D, a one-factor analysis of variance as described by Bruning and Kintz (1977) was administered. The analysis of variance was selected as an experimental design because of its accuracy and simplicity in comparing the means of several unequal groups. The basic computational formula was:

$$\text{C. diff.} = \sqrt{(a-1)\, F_{df\ a-1,\ df\ error}} \sqrt{\frac{2 \text{ ms within gps.}}{n \text{ (per gp.)}}}$$

A .05 alpha level was selected as the criterion for statistical significance. The .05 level is standard in educational research and any group differences at this level was believed to be educationally practical. The alteration of or initiation of review discussions in the classroom would not demand critical methodological or economical changes.

The ANOVA demonstrated the significance among the four treatment groups, but would not reveal the actual significance between each set of group comparison possibilities. The Sheffé technique for multiple comparisons was used for this purpose. The Sheffé method of multiple comparisons is generally regarded as superior to the more common T-method of multiple comparisons (Glass and Stanley, 1970).

Since the statistic used in a one-factor ANOVA allows the use of only one score per subject, the two retention test scores for each subject had to be combined. A z-score process (Brown, 1970) was used to insure that the scaling of the two tests was equated. The computational formula was:

$$z = \frac{x - \bar{x}}{s}$$

The resulting z-scores were then altered by a T-score transformation (Brown, 1970) to insure that all scores were positive when used in the ANOVA. The computational formula was: $10z + 50$.

Hypothesis

The following null hypothesis was employed in the study: There is no significant difference in grade achievement among students receiving immediate reviews of in-class presented material, students receiving delayed reviews of in-class presented material, students receiving both immediate and delayed reviews of in-class presented material, and students receiving no reviews of in-class presented material.

The null hypothesis can be expressed symbolically as:

$$H_o: \mu_A = \mu_B = \mu_C = \mu_D$$

The hypothesis tested was that the difference between the means of four populations $\mu_A - \mu_B - \mu_C - \mu_D$ was equal to zero. The null hypothesis H_o was tested by means of a one-way analysis of variance.

CHAPTER IV

ANALYSIS OF THE DATA

Introduction

The purpose of the study was to determine the most effective time to give teacher-summary reviews on in-class presented material as an aid to student retention. An experimental comparison was administered to determine the effects of temporal positioning of teacher-conducted reviews on the retention of instructional material at the community college level. The study was conducted at Central Texas College and involved 63 freshman students enrolled in two night sections of basic English. Specifically, the experiment compared the effects of no reviews, immediate reviews, delayed reviews, and a combination of immediate and delayed reviews as they related to student retention. Reviews were presented in the form of 10 minute teacher-summaries.

Each of the four randomly selected groups involved in the study received their respective treatment over eleven class sessions. Two objective retention tests were administered to all groups and the test scores were combined by a z-score conversion (Brown, 1970) and used in a one factor analysis of variance coupled with the Sheffé technique (Bruning and Kintz, 1977) for multiple comparisons. The one factor in the analysis involved only the temporal positioning of reviews and the following null hypothesis was employed in the study:

Hypothesis

There is no significant difference in grade achievement among

students receiving immediate reviews of in-class presented material, students receiving delayed reviews of in-class presented material, students receiving both immediate and delayed reviews of in-class presented material, and students receiving no reviews of in-class presented material. The null hypothesis had been expressed symbolically as:

$$\mu_a = \mu_b = \mu_c = \mu_d$$

Findings

The data resulting from the study were based on an examination of each student's achievement scores on two tests with a maximum combined value of 200 points. Each student was in one of four treatment groups. Group A received no reviews and had 15 students. Group B received immediate reviews and had 16 students. Group C received delayed reviews and had 17 students. Group D received both immediate and delayed reviews and had 15 students. Table III represents the raw data test scores achieved by the four treatment groups.

TABLE III

RAW TEST SCORES FOR REVIEW GROUPS

GROUP A NO REVIEW			GROUP B IMMEDIATE		GROUP C DELAYED		GROUP D IMMEDIATE & DELAYED	
	T_1	T_2	T_1	T_2	T_1	T_2	T_1	T_2
1.	60	70	93	88	78	73	100	86
2.	70	70	70	92	59	70	94	94
3.	67	80	86	94	100	92	100	100
4.	85	72	92	98	78	73	86	94
5.	65	60	90	96	76	64	100	94
6.	68	69	100	99	88	87	100	86
7.	92	75	97	93	82	85	88	80
8.	79	75	97	90	80	81	94	90
9.	82	76	93	88	62	77	100	98
10.	80	70	90	87	80	82	100	90
11.	83	79	83	93	100	92	65	88
12.	86	73	91	97	66	82	100	96
13.	70	83	89	91	94	90	100	94
14.	78	75	90	93	88	89	100	98
15.	85	73	91	93	77	84	93	83
16.			83	79	98	89		
17.					78	85		

Table III displays the raw test scores of each student (N) in each of the four review treatment groups. Each student received two tests (T_1 and T_2) during the treatment period.

To analyze the raw-data scores with a one factor analysis of variance, the two test scores for each student had to be combined. A z-score process (Brown, 1970) was used to combine the test scores to insure that the scaling of the two tests was equated. The resulting z-scores were then altered by a T-score transformation (Brown, 1970) to insure that all scores were positive when used in the ANOVA.

The mean scores and standard deviations of the four groups appear in Table IV.

TABLE IV

MEANS AND STANDARD DEVIATIONS FOR REVIEW GROUPS

	Group A No Review N = 15	Group B Immediate N = 16	Group C Delayed N = 17	Group D Immediate & Delayed N = 15
$\bar{X}$	30.85	60.90	43.79	64.61
S	10.54	8.42	16.98	11.20

Table IV displays the mean scores and standard deviation figures for group A which received no reviews, for group B which received immediate reviews, for group C which received delayed reviews, and for group D which received both immediate and delayed reviews. The test-achievement mean score for group A was 30.85. The standard deviation of the group A test scores was 10.54. The test-achievement mean score for group B was 60.90. The standard deviation of the group B test scores

was 8.42. The test-achievement mean score for group C was 43.79. The standard deviation of the group C test scores was 16.98. The test-achievement mean score for group D was 64.61. The standard deviation of the group D test scores was 11.20. In a ranking of group mean scores the immediate and delayed review group D had the highest mean followed respectively by the immediate group B, the delayed group C, and the no review group A.

A one factor analysis of variance was administered to measure the comparison of test-achievement mean scores among the four groups. A .05 alpha level was used as the criterion for statistical significance. The results of this analysis appear in Table V.

TABLE V

ANOVA RESULTS

Source	SS	DF	MS	F
Between Groups	11,261.25	3	3,753.75	23.10 *
Within Groups	9,587.06	59	162.49	
Total	20,848.31	62		

α = .05

critical F = 2.78 (with 3 and 59 degrees of freedom)

* F = $\frac{3753.75}{162.47}$ = 23.10

Table V represents the sum of squares, degrees of freedom and mean squares between the four review groups and within the four review groups. The F ratio was 23.10 and the critical F value at 3 and 59 degrees of freedom was 2.78 at the .05 alpha level of significance.

Although the analysis of variance yielded a significant F value, it did not attribute the significance between specific groups. To uncover the groups actually contributing to the significant result, a Sheffé technique (s-method) of multiple comparisons was used. (Bruning and Kintz, 1977). The s-method was used to test the significance of the following differences between sample means:

$$\bar{X}_a - \bar{X}_b \qquad \bar{X}_b - \bar{X}_c$$
$$\bar{X}_a - \bar{X}_c \qquad \bar{X}_b - \bar{X}_d$$
$$\bar{X}_a - \bar{X}_d \qquad \bar{X}_c - \bar{X}_d$$

An s-method calculation for the significance of contrasts among the means produced a critical t-value of 4.55. It was concluded, therefore, that there was a significant difference between the means of group A and group B, between the means of group A and group C, between the means of group A and group D, between the means of group B and group C, and between the means of group C and group D. There was no significant difference between the means of group B and group D.

This calculation of significance between the group means is represented symbolically as:

$$\mu_A \quad \mu_B \quad \mu_C = \mu_D$$

The significance between group mean scores occurred in the following rank order as expressed in Table VI.

TABLE VI

RANK ORDER OF DIFFERENCE BETWEEN MEANS OF REVIEW GROUPS

$\tilde{D}$	-	$\tilde{A}$	=	33.76
Immediate & Delayed		No review		
$\tilde{B}$	-	$\tilde{A}$	=	30.05
Immediate		No review		
$\tilde{D}$	-	$\tilde{C}$	=	20.82
Immediate & Delayed		Delayed		
$\tilde{B}$	-	$\tilde{C}$	=	17.11
Immediate		Delayed		
$\tilde{C}$	-	$\tilde{A}$	=	12.94
Delayed		No review		
$\tilde{D}$	-	$\tilde{B}$	=	3.71
Immediate & Delayed		Immediate		

Critical t = 4.55

Table VI represents a rank order of difference between the means of the four review groups. Group D, which received both immediate and delayed reviews, had a mean difference of +33.76 when compared to the mean of group A, which received no reviews. Group B, which received immediate reviews, had a mean difference of +30.05 when compared to the mean of group A, which received no reviews. Group D, which received both immediate and delayed reviews, had a mean difference of +20.82 when compared to the mean of group C, which received delayed reviews. Group B, which received immediate reviews, had a mean difference of +17.11 when compared to the mean of group C, which received delayed reviews. Group C, which received delayed reviews, had a mean difference of 12.94 when compared to the mean of group A, which received no reviews. Group D, which received both immediate and delayed reviews, had a mean difference of 3.71 when compared to the mean of group B, which received immediate reviews. The critical t' produced by the Sheffé method for multiple contrasts was 4.55.

CHAPTER V

CONCLUSIONS AND IMPLICATIONS

Summary of the Study

The primary objective in this study was to determine the most effective time to give teacher-summary reviews on in-class presented material as an aid to student retention. An experimental comparison was administered at the community college level to assess the effects of three review treatments according to their temporal position. The treatments included teacher-summary reviews given immediately following a class session, teacher-summary reviews given before the next class session after a delay of two to five days, teacher-summary reviews combining both those immediately following the class sessions and those preceding the next class sessions after a delay of two to five days, and a control group to which no reviews were given. Results of the study were of interest to college officials (Appendix B) and were expected to be useful in facilitating student retention.

The study was conducted at Central Texas College and involved 63 freshman students enrolled in two night sections of basic English grammar. Each of the four randomly selected groups received their respective treatment over eleven class sessions. Two objective retention tests were administered to four groups and the test scores were combined by a z-score conversion (Brown, 1970) and used in a one factor analysis of variance coupled with the Sheffé technique (Bruning and Kintz, 1977) for multiple comparisons. The one factor in the analysis

involved only the temporal positioning of reviews. A null hypothesis was employed in the study where no significant difference among the treatments was hypothesized.

An extensive review of the literature on the subject of student retention revealed contrasting results and there was no conclusive evidence that any particular review time, immediate, delayed, or a combination of the two, was better for facilitating student retention (Horwitz, 1975; Vitro, 1975; Gay, 1973; Reynolds and Glasser, 1964; Ausubel, 1968). At least one researcher (Dunn, 1971) stated that the value and temporal position of reviews was insignificant altogether. Far more evidence, however, supported the precept that reviews facilitate retention and student performance. The major disagreement in the literature reviewed involved the temporal positions of those reviews. Ausubel (1968) postulated a solution to the long-standing disagreement by stating that each review time, immediate or delayed, had its respective advantages and perhaps they could be profitably combined for even greater retention.

Conclusions

The one-factor ANOVA yielded a significant F value at the .05 alpha level. The null hypothesis $\mu_a = \mu_b = \mu_c = \mu_d$ was rejected. The Sheffé calculation for multiple comparisons between the means of the four treatment groups produced a critical t value of 4.55. It was concluded, therefore, that there was a significant difference in retention tests mean scores between the immediate review group and the no-review group, between the delayed review group and the no-review group, between the combined immediate and delayed review

group and the no-review group, between the immediate review group and the delayed review group, and between the delayed review group and the combined immediate and delayed group. There was no significant difference between the immediate review group and the combined immediate and delayed group.

Implications

From the analysis of the data, it was clear that some form of review, immediate, delayed, or a combination of the two, was significantly better for student retention and performance than no review whatsoever. Of specific interest then, was the best temporal position for teacher-summary reviews. The rank order of the greatest significance between the review treatments and no review implies that the greatest benefit of reviews occurred with the combined immediate and delayed review treatment. There was, however, no significant difference between the performance of students in the combined immediate and delayed review group and the performance of students in the immediate review group. This suggests that it may be uneconomical to include both an immediate and a delayed review in the classroom since the single treatment of an immediate review will have virtually the same effect on student retention and performance as would a combination of immediate and delayed review treatments.

There was a significant difference between the delayed review group mean (43.79) and the no-review group mean (30.85) which suggests that a delayed review in the classroom will facilitate student retention and recall. However, an examination of the difference between the immediate review group mean (60.9) and the delayed review group mean

(43.79) also revealed a significance. Further, there was also a significant difference between the combined immediate and delayed group mean (64.61) and the delayed group mean (43.79). It appears that although delayed reviews will facilitate student performance, immediate or combined immediate and delayed reviews will facilitate student performance to a higher degree.

The primary implications of this experiment can be summarized as follows:

1. Teacher-summary reviews, immediate, delayed or a combination of the two, of in-class presented material facilitate student performance on objective retention tests at the community college level.
2. On the community college level, teacher-summary reviews immediately following class sessions of one to one and one-half hours produce a higher level of student performance on retention tests than do delayed reviews.
3. Teacher-summary reviews immediately following a community college level class session are more practical and economical than teacher summary reviews which are given on both an immediate and a delayed basis.

This experiment demonstrates a validity to Ausubel's (1968) postulation that both immediate and delayed reviews have their own set of advantages for student retention. It does not, however, demonstrate that the two review times can be profitably combined in an economical

sense. The value of immediate reviews is just as great as the value of the combined immediate and delayed reviews.

It was recognized that various factors might have influenced the results especially since it was impossible to maintain control over the reviewing behavior of the students. However, the degree of significance between the groups at the .05 level indicated that the Hawthorne effect (Turney and Robb, 1971) was insignificant and that the significance between the treatment means was more than a sampling error (Issac, Stephen and Michael, 1972).

The results of this experiment have a practical application to the teaching methods used at Central Texas College. It was recommended to the Dean of the College that the implications of the findings be shared with all part-time and full-time faculty and that the use of immediate review procedures be encouraged.

Recommendations

The results of this experiment appear to have significant implications for the teaching of in-class presented material at the community college level, at night, with part-time instructors, when measured by objective retention tests, and when involving relatively familiar subject content. It is suggested that any expansion or replication of this study should address different variables and conditions which would result in more conclusive and broader implications for teaching and student performance.

Based on the results, observations and subsequent subjective conclusions of the study, it is recommended that:

1. The study should be repeated at different educational levels.
2. The study should be repeated at the community college level during day classes and with a full-time instructor.
3. The study should be repeated in classes which involve more subjective and non-familiar subject matter.
4. The study should be repeated to include long-term retention testing as well as short-term retention testing.

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APPENDIX A

CENTRAL TEXAS COLLEGE

M E M O R A N D U M

DATE: May 26, 1978

TO: Mr. P. Anthony Zeiss

FROM: Pauline Blackburn *pb*

SUBJECT: Research on Review and Retention

As we have discussed, an on-campus investigation of the immediate verses delayed reviews of in-class presented material is of significant interest to the Education Department of the University. I am looking forward to the results and the classroom implications will be shared with all departmental instructors.

APPENDIX B

Central Texas College

HIGHWAY 190 WEST
BELL-CORYELL COUNTIES
KILLEEN, TEXAS 76541

MEMORANDUM

DATE: October 10, 1978

TO: P.. Anthony Zeiss

FROM: Dean John W. Moffitt

SUBJECT: Learning Theory Research

As chairman of the Instructional Improvement Committee it seems most appropriate that you have chosen a dissertation topic which relates to learning theory. Please be assured that on-campus investigation of the effects of review positions in regard to learning retention is of significant interest to Central Texas College. The results will be shared with all departmental managers with appropriate recommendations.